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REDUCED TILLAGE CROP ROTATION STUDY

Enclosed is a copy of the above titled paper written by C. E. Stymiest and B. A. Swan. C. E. Stymiest is the South Dakota West River Extension Agronomist and B. A. Swan is a member of his staff.

The paper compares the various reduced tillage systems on plots on the Bonnie Silvage farm near Hayes, South Dakota. It includes the yields for 1991, the economics on each system for 1991, and the average net income for the last three years for each system.

The comments, discussion of results, and summary sections of this paper provide some insight on why the various systems are performing as observed.

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Enclosure

File under: Agronomy

REDUCED TILLAGE CROP ROTATION STUDY

Bonnie Sivage Farm Hayes SD.

C.E.STYMIEST & B.A.SWAN

Objectives: 1) To maintain at least 30% residue cover on the soil surface at all times. 2) Evaluate the net income from each rotation each year. 3) Evaluate changes in soil tilth, weed present and disease occurrence.

Experimental Design: The crop rotations include 5 cropping sequences which vary from 2 to 5 years in duration. The cropping sequences have been maintained from 1987 to the present. The rotation are replicated 4 times in a randomized complete block design.

Funding: South Dakota Wheat Commission, SDSU Agricultural Experiment Station and SDSU Cooperative Extension Service.

Rotations:

A: Winter Wheat / Summer Fallow

A combination of herbicides and tillage are being used to maintain a 30 percent soil residue cover.

B. Winter Wheat / Millet

A continuous cropping rotation planted no-till and maintains excellent soil protection. Herbicides are used to control weeds.

C. Winter Wheat / Milo / Millet / Barley

A continuous cropping system that includes 1 year of row crop and 3 years of small grains.

D. Winter Wheat / Milo / Oats / Winter Wheat / Summer Fallow

The longest rotation that includes reduced tillage methods of growing small grains and row crop as well as a summer fallow period.

E. Winter Wheat / Milo / Summer Fallow

The standard Ecofallow rotation which has shown significant yield increases over conventionally planted grain sorghum in past research.

Comments:

Winter wheat crop rotations are dependent on fall and spring moisture to develop full yield potential. The fall of 1990 was extremely dry during September and October. The winter wheat planted on summer fallow germinated and emerged uniformly because there was moisture near the surface in the reduced tillage summer fallow. The winter wheat no-till planted into small grain and millet stubble did not germinate until late in the fall and the stand was thin in the fall. As a result of the dry weather in the fall the stubble planted wheat had a slow start in the spring. The above normal moisture received during April through the first half of June helped the crop develop yield potential (table 1.).

Table 1. Grain yields from the 1991 growing season of the reduced tillage crop rotation study at Hayes SD.

Rot Crop	Yield Bu./A.	Crop	Yield Bu./A.	Crop	Yield Bu./A.	Crop	Yield Bu./A.
A W.Wheat	46.0	Fallow					
B W.Wheat	31.9	Millet	33.7				
C W.Wheat	32.0	Milo	26.3	Millet	32.9	Barley	52.2
D W.Wheat	49.8	Milo	39.9	Oats	62.4	W.Wheat	36.0
	Fallow						
E W.Wheat	47.0	Milo	33.2	Fallow			

Discussion Of Results:

The rotations have been maintained under reduced and no-tillage methods from 1987 through the present. The crop yields and the cost of crop production has been recorded each year. The cost of production and income for the 1991 crop is listed in this report. The 3 year yields were also used to make long term comparisons with 1991. The 3 year averages are more meaningful than 1 years data. This point is demonstrated in rotation D. During 1991 this rotation had an excellent return of \$34.34 per acre. Rotation D. during the period 1989-1990-1991 had a 3 year average net income of \$14.88 per acre. The changes in prices received for each crop has a major influence on which rotation has an economic advantage. An example of this would be the price of millet has remained at a historical low with an average of 3 cents per pound. If the price of millet increased to 5 cents per pound rotations including millet would look much better.

ROTATION A.

WINTER WHEAT / SUMMER FALLOW

Cost /A.	1991 Winter Wheat Crop After Fallow
\$ 7.85	Reduced Tillage Planting Sept. 1990
5.25	1 Bu./A. TAM 107 Winter Wheat Seed
7.56	6 gal/A.(10-34-0) Starter Fertilizer
6.48	Ally + 2,4-D ester Applied May 1991
17.20	Harvesting 46 Bu./A. Winter Wheat
17.00	Land Charges 1991
61.59	Total Cost Of Production 1991

ROTATION A
WINTER WHEAT / SUMMER FALLOW
1991 Summer Fallow

Cost / A.	
\$ 5.55	1 qt./A. Atrazine Fall Applied 1990
6.48	10 ounces /A. Roundup May 1991
4.50	June Tillage
3.82	2,4-D ester Applied August 1991
6.45	10 ounces /A. Roundup Sept. 1991
17.00	Land Charges
43.80	Total Cost Of 1991 Summer Fallow

ROTATION A ECONOMIC SUMMARY 1991
WINTER WHEAT / SUMMER FALLOW

Income		Expenses	
39.10	Def. Payment	61.59	Cost Of Wheat Crop
119.60	Sale Of Wheat	2.73	Cost Of Set Aside
		43.80	Cost Of Fallow
158.70	Total Income	105.39	Total Cost Of Prod.

53.31 Dollars Income Per 2 Years
26.66 Dollars Income Per Year In 1991
23.21 Dollars 3 Year Average Income Per Year

ROTATION B
WINTER WHEAT / PROSO MILLET
Cost / A. 1991 Winter Wheat Crop After Millet

Cost / A.	
\$ 6.48	10 ounces /A. Roundup Sept 1990
7.85	No-Till Planting Of Winter Wheat
5.25	1 Bu./A. TAM-107 Wheat Seed
7.25	6 gal/A. (10-34-0) Starter Fertilizer
6.00	Broadcast Nitrogen Fertilizer Fall 1990
6.29	Ally+2,4-D ester Applied May 1991
14.50	Harvest 32 Bu./A. Winter Wheat
17.00	Land Charges 1991
70.62	Total Cost Of Production

ROTATION B
WINTER WHEAT / PROSO MILLET
Cost /A. 1991 Millet Crop After Winter Wheat

Cost /A.	
\$ 5.55	1 qt. /A. Atrazine Applied Fall 1990
6.48	10 ounces Roundup Applied May 1991
7.85	No-Till Planting Of Millet June 1991
2.00	20 Lbs./A. Sunup Millet Seed
14.00	Harvesting 33.7 Bu./A. Millet
17.00	Land Charges 1991
52.88	Total Cost Of Production For Millet Crop

ROTATION B ECONOMIC SUMMARY
WINTER WHEAT / PROSO MILLET

Income		Expenses	
50.55	Sale Of Millet	52.88	Millet Crop
39.10	Def. Payment	70.62	Wheat Crop
82.94	Sale Of Wheat	123.50	Total Expenses
172.59	Total Income		
49.10 Dollars Net Income Per 2 Years			
24.55 Dollars Net Income Per In 1991			
16.50 Dollars 3 Year Average Net Income Per Year			

ROTATION C
WINTER WHEAT / MILO / MILLET / BARLEY

Cost /A.		1991 Winter Wheat Crop After Barley
\$	6.48	10 ounces Roundup Applied August 1990
	7.85	No-Till Planting Of Winter Wheat Sept. 1990
	5.25	1 Bu./A. TAM-107 Winter Wheat Seed
	7.56	6 gal/A. (10-34-0) Starter Fertilizer
	6.29	Ally+2,4-D ester Applied April 1991
	14.40	Harvest 32 Bu./A. Winter Wheat
	17.00	Land Charges 1991
	64.95	Total Cost Of Production 1991

ROTATION C
WINTER WHEAT / MILO / MILLET / BARLEY

Cost /A.		1991 Milo Crop After Winter Wheat
\$	8.60	2 qt./A. Atrazine Applied fall 1990
	10.85	No-Till Planting And Seed Cost
	10.08	8 gal./A. (10-34-0) Starter Fertilizer
	4.75	Cultivate Milo
	9.20	Nitrogen Fertilizer Applied June 1991
	13.38	Harvest 26.9 Bu./A. Milo
	17.00	Land Charges 1991
	72.86	Total Cost Of Production

ROTATION C
WINTER WHEAT / MILO / MILLET / BARLEY

Cost /A.		1991 Millet Crop After Milo
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\$	3.65	8 ounces /A. 2,4-D ester Applied May 1991
	7.85	No-Till Planting Of Millet
	2.00	20 Lbs./A. Sunup Millet Seed
	7.56	6 gal./A. (10-34-0) Starter Fertilizer
	14.58	Harvest 32.9 Bu./A. Millet
	17.00	Land Charges 1991
	52.64	Total Cost Of Millet Production

ROTATION C
WINTER WHEAT / MILO / MILLET / BARLEY
Cost /A. 1991 Barley Crop After Millet

\$ 11.85	No-Till Planting 2 Bu./A. Bowman
7.56	6 gal./A. (10-34-0) Starter Fertilizer
3.65	2,4-D Amine Applied May 1991
18.44	Harvest 52.2 Bu./A. Barley
17.00	Land Charges 1991
58.50	Total Cost Of Production

ROTATION C ECONOMIC SUMMARY
WINTER WHEAT / MILO / MILLET / BARLEY
Income Expenses

83.20	Sale Of Wheat	64.95	Wheat Crop
39.10	Def. Payment	72.88	Milo Crop
44.18	Sale Of Milo	52.64	Millet Crop
49.35	Sale Of Millet	58.50	Barley Crop
83.52	Sale Of Barley	248.97	Total Expenses
299.35	Total Income		

50.38 Dollars Net Income From The Rotation 1991
12.60 Dollars Net Income Per Year For 1991
6.97 Dollars 3 year Average Net Income Per Year

ROTATION D
WINTER WHEAT / MILO / OATS / WINTER WHEAT / FALLOW
Cost /A. Winter Wheat After Fallow 1991

\$ 7.85	Reduced Tillage Planting Sept. 1990
5.25	1 Bu./A. TAM-107 Winter Wheat Seed
7.56	6 gal./A. (10-34-0) Starter Fertilizer
6.29	Ally+2,4-D ester Applied May 1991
17.90	Harvest 49.8 Bu./A. Winter Wheat
17.00	Land Charges 1991
61.85	Total Cost Of Production

ROTATION D
WINTER WHEAT / MILO / OATS / WINTER WHEAT / FALLOW
Cost /A. Oats After Milo 1991

\$ 7.85	No-Till Planting Of Oats Crop
4.30	2 Bu./A. Hytest Oats Seed
3.65	2,4-D amine Applied May 1991
14.48	Harvest 62.4 Bu./A. Oats Crop
17.00	Land Charges 1991
42.28	Total Cost Of Production 1991

ROTATION D

WINTER WHEAT / MILO / OATS / WINTER WHEAT / FALLOW
Cost /A. Milo After Winter Wheat 1991

\$ 8.60	2 qt./A. Atrazine Applied Fall 1990
10.85	No-Till Planting Milo + Seed
10.08	8 gal./A.(10-34-0) Starter Fertilizer
4.75	Cultivate Milo
9.20	Broadcast Nitrogen Fertilizer
15.98	Harvest 39.9 Bu./A. Milo
17.00	Land Charges 1991
76.46	Total Cost Of Production 1991

ROTATION D

WINTER WHEAT / MILO / OATS / WINTER WHEAT / FALLOW
Cost /A. Winter Wheat After Oats 1991

\$ 6.48	10 ounces /A. Roundup Sept. 1990
7.85	No-Till Planting Of Winter Wheat
5.25	1 Bu/A. TAM-107 Winter Wheat Seed
7.56	6 gal./A.(10-34-0) Starter Fertilizer
12.50	8 gal./A.(28-0-0) Broadcast Nitrogen
6.29	Ally + 2,4-D ester Applied April 1991
15.20	Harvest 36.0 Bu./A. Winter Wheat Crop
17.00	Land Charges 1991
71.65	Total Cost Of Production 1991

ROTATION D

WINTER WHEAT / MILO / OATS / WINTER WHEAT / FALLOW
Cost /A. Summer Fallow 1991

\$ 5.55	1 qt./A. Atrazine Fall Applied 1990
6.48	10 ounces /A. Roundup May 1991
4.50	June Tillage Chisel+Rodweeder
3.82	2,4-D ester Applied August 1991
17.00	Land Charges
37.35	Total Cost Of Summer Fallow 1991

ROTATION D ECONOMIC SUMMARY
WINTER WHEAT / MILO / OATS / WINTER WHEAT / FALLOW

Income		Expenses	
129.48	Sale Of Wheat	61.85	Wheat On Fallow
39.10	Def. Payment	76.46	Milo Crop
67.03	Sale Of Milo	47.28	Oats Crop
78.00	Sale Of Oats	71.65	Wheat After Oats
93.60	Sale Of Wheat	37.35	Cost Of Fallow
39.10	Def. Payment	294.59	Total Expenses
466.31	Total Income		

Net Income For Rotation \$ 171.72
Net Income Per 1991 34.34
Net Income 3 Year Ave. 14.88

ROTATION E
WINTER WHEAT / MILO / FALLOW

Cost /A.		Winter Wheat After Fallow 1991	
\$ 7.85	Reduced Tillage Planting Of Winter Wheat		
5.25	1 Bu./A. TAM-107 Winter Wheat Seed		
7.56	6 gal./A. (10-34-0) Starter Fertilizer		
6.29	Ally + 2,4-D ester Applied May 1991		
17.40	Harvest 47.0 Bu./A. Winter Wheat Crop		
17.00	Land Charges 1991		
61.35	Total Cost Of Winter Wheat Production 1991		

ROTATION E
WINTER WHEAT / MILO / FALLOW

Cost /A.		Milo After Winter Wheat 1991	
\$ 10.13	2.5 qt./A. Atrazine Fall Applied 1990		
10.85	No-Till Planting Milo + Seed		
10.08	8 gal./A. (10-34-0) Starter Fertilizer		
4.75	Cultivate Milo		
9.20	Broadcast Application Of Nitrogen		
14.64	Harvest 33.2 Bu./A. Milo		
17.00	Land Charges 1991		
76.65	Total Cost Of Milo Production 1991		

ROTATION E
WINTER WHEAT / MILO / FALLOW
Cost /A. Summer Fallow 1991

\$ 3.82	2,4-D ester Applied May 1991
4.50	Tillage Late June 1991
6.48	10 ounces /A. Roundup
17.00	Land Charges 1991
31.80	Total Cost Of Summer Fallow

ROTATION E ECONOMIC SUMMARY
WINTER WHEAT / MILO / FALLOW

Income		Expenses	
122.20	Sale Of Wheat	61.35	Winter Wheat Crop
55.78	Sale Of Milo	76.65	Milo Crop
39.10	Def. Payment	31.80	Summer Fallow
217.08	Total Income	169.80	Total Expenses
Net Income From Rotation		\$ 47.28	
Net Income Per Year 1991		15.76	
3 Year Average Net Income		20.92	

Summary:

The objective of maintaining adequate crop residue to be in conservation compliance has been accomplished in rotations A,B,C and D. Rotation E has a marginal amount of milo and wheat straw residue left after the summer fallow period. There has been 20 to 30 percent soil cover after planting of the winter wheat crop. There has been no serious weed or disease problems identified in the rotations. The annual weeds have become less of a problem in all rotation except the winter wheat / millet rotation.

The soil organic matter had an average test of 2.53 percent in the top 6 inches of soil in 1987 and the same plots averaged 3.44 percent in the top 6 inches in the fall of 1991. The reduced tillage crop rotations have been good for the soil during this period of time.

The economic summary would indicate the 3 year average would favor the rotations containing more wheat. The effects of the long term rotations are just starting to develop and longer term research will be necessary to evaluate these effects.